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SuperH™ Family E10A-USB Emulator

Additional Document for User's Manual
Supplementary Information on Using the SH7136 and SH7137

Renesas Microcomputer Development Environment System

SuperH™ Family

E10A-USB for SH7137 HS7137KCU01HE

User's Manual

Rev.1.00

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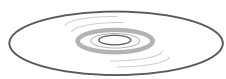
Section 1 Connecting the Emulator with the User System

1.1 Components of the Emulator

The E10A-USB emulator supports the SH7136 and SH7137. Table 1.1 lists the components of the emulator.

Table 1.1 Components of the Emulator

Classification	Component	Appearance	Quantity	Remarks
Hardware	Emulator box		1	HS0005KCU01H: Depth: 65.0 mm, Width: 97.0 mm, Height: 20.0 mm, Mass: 72.9 g or HS0005KCU02H: Depth: 65.0 mm, Width: 97.0 mm, Height: 20.0 mm, Mass: 73.7 g
	User system interface cable		1	14-pin type: Length: 20 cm, Mass: 33.1 g
	User system interface cable		1	36-pin type: Length: 20 cm, Mass: 49.2 g (only for HS0005KCU02H)
	USB cable		1	Length: 150 cm, Mass: 50.6 g
Software	E10A-USB emulator setup program, SuperH™ Family E10A-USB Emulator User's Manual, Supplementary Information on Using the SH7136 and SH7137*, and Test program manual for HS0005KCU01H and HS0005KCU02H		1	HS0005KCU01SR, HS0005KCU01HJ, HS0005KCU01HE, HS7137KCU01HJ, HS7137KCU01HE, HS0005TM01HJ, and HS0005TM01HE (provided on a CD-R)

Note: Additional document for the MCUs supported by the emulator is included. Check the target MCU and refer to its additional document.

1.2 Connecting the Emulator with the User System

To connect the E10A-USB emulator (hereinafter referred to as the emulator), the H-UDI port connector must be installed on the user system to connect the user system interface cable. When designing the user system, refer to the recommended circuit between the H-UDI port connector and the MCU. In addition, read the E10A-USB emulator user's manual and hardware manual for the related device.

Table 1.2 Type Number and Connector Type

Type Number	Connector
HS0005KCU01H, HS0005KCU02H	14-pin connector

1.3 Installing the H-UDI Port Connector on the User System

Table 1.3 shows the recommended H-UDI port connector for the emulator.

Table 1.3 Recommended H-UDI Port Connector

Connector	Type Number	Manufacturer	Specifications
14-pin connector	2514-6002	Minnesota Mining & Manufacturing Ltd.	14-pin straight type

Note: Do not place any components within 3 mm of the H-UDI port connector.

1.4 Pin Assignments of the H-UDI Port Connector

Figure 1.1 shows the pin assignments of the H-UDI port connector.

Note: Note that the pin number assignments of the H-UDI port connector shown on the following page differ from those of the connector manufacturer.

Pin No.	Signal		Input/ Output*1	SH7136 Pin No.	SH7137 Pin No.	Note
1	TCK		Input	6	7	
2	_TRST	*2	Input	2	2	
3	TDO		Output	4	5	
4	_ASEBRKAK / _ASEBRK	*2	Input/ output	7	8	
5	TMS		Input	3	4	
6	TDI		Input	5	6	
7	_RES	*2	Output	54	70	User reset
8	N.C.		—			
9	(GND)	*4	—			
11	UVCC		Output			
10, 12, and 13	GND		—			
14	GND	*3	Output			

Notes: 1. Input to or output from the user system.
2. The symbol (_) means that the signal is active-low.
3. The emulator monitors the GND signal of the user system and detects whether or not the user system is connected.
4. When the user system interface cable is connected to this pin and the _ASEMD0 pin is set to 0, do not connect to GND but to the _ASEMD0 pin directly.

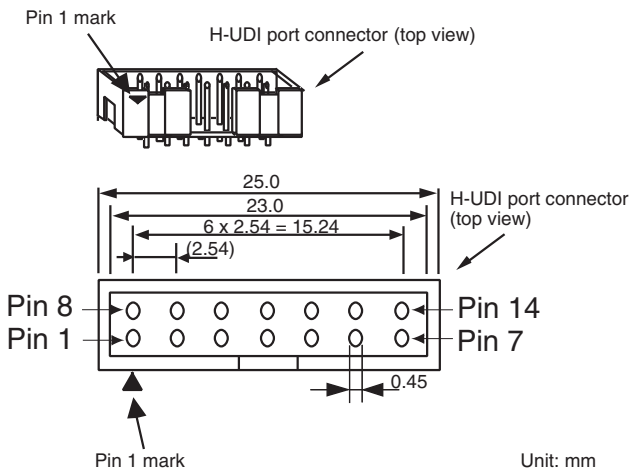


Figure 1.1 Pin Assignments of the H-UDI Port Connector (14 Pins)

1.5 Recommended Circuit between the H-UDI Port Connector and the MCU

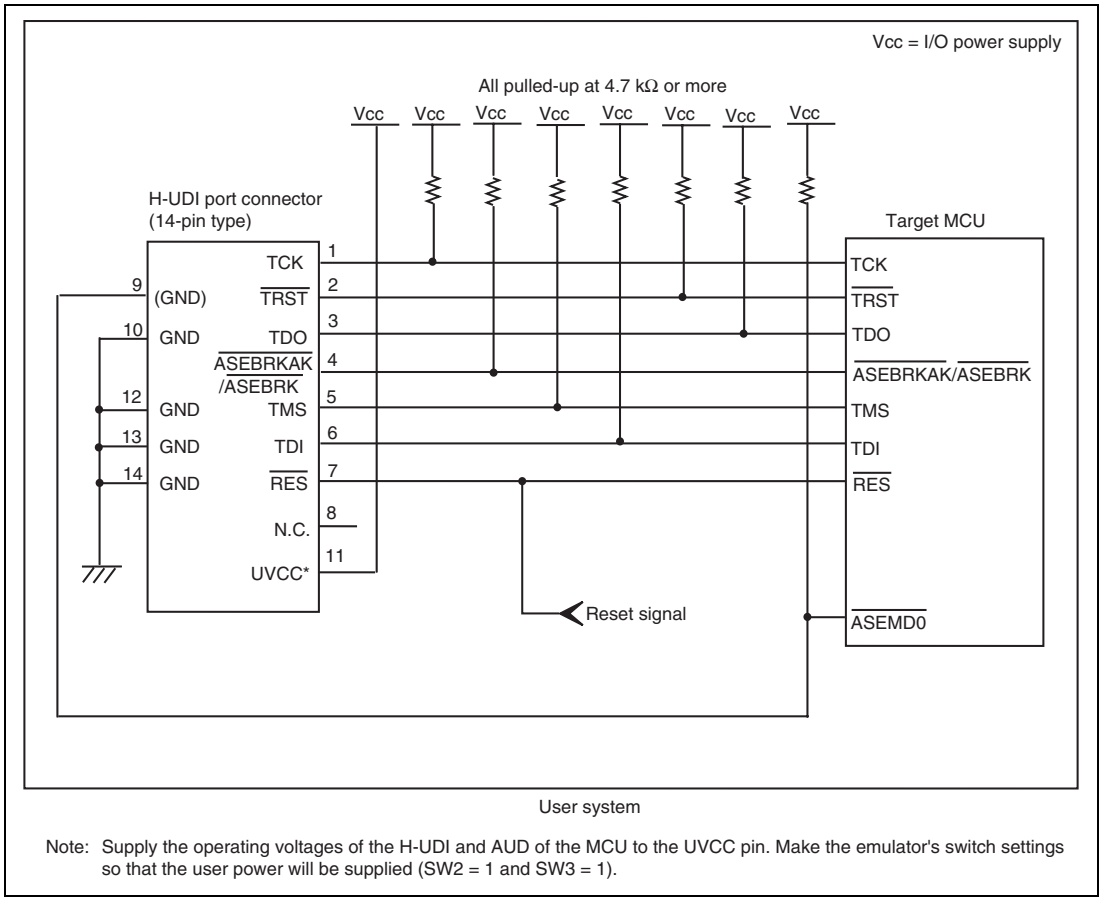
1.5.1 Recommended Circuit (14-Pin Type)

Figure 1.2 shows a recommended circuit for connection between the H-UDI port connector (14 pins) and the MCU when the emulator is in use.

Notes: 1. Do not connect anything to the N.C. pins of the H-UDI port connector.

2. The _ASEMD0 pin must be 0 when the emulator is connected and 1 when the emulator is not connected, respectively.
   (1) When the emulator is used: _ASEMD0 = 0
   (2) When the emulator is not used: _ASEMD0 = 1
   Figure 1.2 shows an example of circuits that allow the _ASEMD0 pin to be GND (0) whenever the emulator is connected by using the user system interface cable.
   When the _ASEMD0 pin is changed by switches, etc., ground pin 9. Do not connect this pin to the _ASEMD0 pin.
3. When a network resistance is used for pull-up, it may be affected by a noise. Separate TCK from other resistances.
4. The pattern between the H-UDI port connector and the MCU must be as short as possible. Do not connect the signal lines to other components on the board.
5. Supply the operating voltage of the H-UDI of the MCU to the UVCC pin. Make the emulator's switch settings so that the user power will be supplied (SW2 = 1 and SW3 = 1).
6. The resistance value shown in figure 1.2 is for reference.
7. For the pin processing in cases where the emulator is not used, refer to the hardware manual of the related MCU.

When the circuit is connected as shown in figure 1.2, the switches of the emulator are set as SW2 = 1 and SW3 = 1. For details, refer to section 3.8, Setting the DIP Switches, in the SuperH™ Family E10A-USB Emulator User's Manual.



Note: Supply the operating voltages of the H-UDI and AUD of the MCU to the UVCC pin. Make the emulator's switch settings so that the user power will be supplied (SW2 = 1 and SW3 = 1).

Figure 1.2 Recommended Circuit for Connection between the H-UDI Port Connector and MCU when the Emulator is in Use (14-Pin Type)

Section 2 Software Specifications when Using the SH7136 and SH7137 Series

2.1 Differences between the MCU and the Emulator

1. When the emulator system is initiated, it initializes the general registers and part of the control registers. The initial values of the MCU are undefined. When the emulator is initiated from the workspace, a value to be entered is saved in a session.

Table 2.1 Register Initial Values at Emulator Link Up

Register	Emulator at Link Up
R0 to R14	H'00000000
R15 (SP)	Value of the SP in the power-on reset vector table
PC	Value of the PC in the power-on reset vector table
SR	H'000000F0
GBR	H'00000000
VBR	H'00000000
MACH	H'00000000
MACL	H'00000000
PR	H'00000000

2. The emulator uses the H-UDI; do not access the H-UDI.
3. Low-Power States
   - When the emulator is used, the sleep state can be cleared with either the clearing function or with the [STOP] button, and a break will occur.
   - The memory must not be accessed or modified in software standby state.
   - When the emulator is used, do not use the deep software standby mode.
4. Reset Signals

   The MCU reset signals are only valid during emulation started with clicking the GO or STEP-type button. If these signals are enabled on the user system in command input wait state, they are not sent to the MCU.

Note: Do not break the user program when the /RES, /BREQ, or /WAIT signal is being low. A TIMEOUT error will occur. If the /BREQ or /WAIT signal is fixed to low during break, a TIMEOUT error will occur at memory access. (Some MCUs will incorporate no /BREQ or /WAIT signal.)

5. Data Transfer Controller (DTC)

   When the MCU incorporates a DTC, the DTC operates even when the emulator is used. When a data transfer request is generated, the DTC executes DTC transfer.

6. Memory Access during User Program Execution

   During execution of the user program, memory is accessed by the following two methods, as shown in table 2.2.

Table 2.2 Memory Access during User Program Execution

Method	Description
H-UDI read/write	The stopping time of the user program is short because memory is accessed by the dedicated bus master.
Short break	This method is not used in this product. (Do not set short break.)

The method for accessing memory during execution of the user program is specified by using the [Configuration] dialog box.

Table 2.3 Stopping Time by Memory Access (Reference)

Method	Condition	Stopping Time
H-UDI read/write	Reading of one longword for the internal RAM	Reading: Maximum 2 bus clocks (Bϕ)
	Writing of one longword for the internal RAM	Writing: Maximum 2 bus clocks (Bϕ)

7. Memory Access to the External Flash Memory Area

   The emulator can download the load module to the external flash memory area (for details, refer to section 6.22, Download Function to the Flash Memory Area, in the SuperH™ Family E10A-USB Emulator User's Manual). Neither memory write nor BREAKPOINT setting is enabled for the external flash memory area. To set the break condition for the program on the external flash memory, use the Event Condition function.

   Some MCUs will incorporate no external flash memory area.

8. Using WDT

   The WDT does not operate during break.

9. Loading Sessions

   Information in [JTAG clock] of the [Configuration] dialog box cannot be recovered by loading sessions. Thus the TCK value will be as follows:

   — When HS0005KCU01H or HS0005KCU02H is used: TCK = 2.5 MHz

10. [IO] Window

   — Display and modification

   For each watchdog timer register, there are two registers to be separately used for write and read operations.

Table 2.4 Watchdog Timer Register

Register Name	Usage	Register
WTCSR (W)	Write	Watchdog timer control/status register
WTCNT (W)	Write	Watchdog timer counter
WTCSR(R)	Read	Watchdog timer control/status register
WTCNT(R)	Read	Watchdog timer counter

   — Customization of the I/O-register definition file

   After the I/O-register definition file is created, the MCU's specifications may be changed. If each I/O register in the I/O-register definition file differs from addresses described in the hardware manual, change the I/O-register definition file according to the description in the hardware manual. The I/O-register definition file can be customized depending on its format. Note that, however, the emulator does not support the bit-field function.

   — Verify

   In the [IO] window, the verify function of the input value is disabled.

11. Illegal Instructions

   Do not execute illegal instructions with STEP-type commands.

12. MCU Operating Mode

   Note that the emulator does not support the boot mode and user boot mode.

13. Multiplexing the Emulator Pins

The emulator pin is assigned as shown in table 2.5.

Table 2.5 Multiplexed Functions

MCU	Function 1	Function 2
SH7136	PE16/TIOC3BS	_ASEBRKAK/_ASEBRK
	PE17/TIOC3DS	TCK
	PE18/TIOC4AS	TDI
	PE19/TIOC4BS	TDO
	PE20/TIOC4CS	TMS
	PE21/TIOC4DS	_TRST
SH7137	PE16/_WAIT/TIOC3BS	_ASEBRKAK/_ASEBRK
	PE17/_CS0/TIOC3DS	TCK
	PE18/_CS1/TIOC4AS	TDI
	PE19/_RD/TIOC4BS	TDO
	PE20/TIOC4CS	TMS

The emulator pins are multiplexed with other pins. When the emulator is connected, function 1 cannot be used because the emulator uses the pins that TCK, TMS, TDI, TDO, _TRST, and _ASEBRKAK/_ASEBRK have been multiplexed.

2.2 Specific Functions for the Emulator when Using the SH7136 and SH7137 Series

2.2.1 Event Condition Functions

The emulator is used to set event conditions for the following two functions:

- Break of the user program
- Start or end of performance measurement

Table 2.6 lists the types of Event Condition.

Table 2.6 Types of Event Condition

Event Condition Type	Description
Address bus condition (Address)	Sets a condition when the address bus (data access) value or the program counter value (before or after execution of instructions) is matched.
Data bus condition (Data)	Sets a condition when the data bus value is matched. Byte, word, or longword can be specified as the access data size.
Bus state condition (Bus State)	There are two bus state condition settings: Bus state condition: Sets a condition when the data bus value is matched. Read/Write condition: Sets a condition when the read/write condition is matched.
Count	Sets a condition when the specified other conditions are satisfied for the specified counts.
Action	Selects the operation when a condition (such as a break, a trace halt condition, or a trace acquisition condition) is matched.

Using the [Combination action (Sequential or PtoP)] dialog box, which is opened by selecting [Combination action (Sequential or PtoP)] from the pop-up menu on the [Event Condition] sheet, specifies the sequential condition and the start or end of performance measurement.

Table 2.7 lists the combinations of conditions that can be set under Ch1 to Ch4.

Table 2.7 Dialog Boxes for Setting Event Conditions

		Function				
Dialog Box		**Address Bus Condition (Address)**	**Data Bus Condition (Data)**	**Bus State Condition (Bus State)**	**Count Condition (Count)**	**Action**
[Event Condition 1]	Ch1	O	O	O	O	O (B and P)
[Event Condition 2]	Ch2	O	O	O	X	O (B and P)
[Event Condition 3]	Ch3	O	X	X	X	O (B)
[Event Condition 4]	Ch4	O	X	X	X	O (B)

Notes: 1. O: Can be set in the dialog box.
X: Cannot be set in the dialog box.

2. For the Action item,
B: Setting a break is enabled. (For the count condition, setting a break is only enabled.)
P: Setting a performance-measurement start or end condition is enabled.

Sequential Setting: Using the [Combination action (Sequential or PtoP)] dialog box specifies the sequential condition and the start or end of performance measurement.

Table 2.8 Conditions to Be Set

Classification	Item	Description
[Ch1, 2, 3] list box	Sets the sequential condition and the start or end of performance measurement using Event Conditions 1 to 3.	
	Don't care	Sets no sequential condition or the start or end of performance measurement.
	Break: Ch3-2-1	Breaks when a condition is satisfied in the order of Event Condition 3, 2, 1.
	Break: Ch2-1	Breaks when a condition is satisfied in the order of Event Condition 2, 1.
	Ch2 to Ch1 PA	Sets the performance measurement period during the time from the satisfaction of the condition set in Event Condition 2 (start condition) to the satisfaction of the condition set in Event Condition 1 (end condition).
	Ch1 to Ch2 PA	Sets the performance measurement period during the time from the satisfaction of the condition set in Event Condition 1 (start condition) to the satisfaction of the condition set in Event Condition 2 (end condition).

Notes: 1. If the start condition is satisfied after the end condition has been satisfied by measuring performance, performance measurement will be restarted. For the measurement result after a break, the measurement results during performance measurement are added.
2. When the start or end of performance measurement is used, the count for specifying the condition of Event Condition 1 must be once.

Usage Example of Sequential Break Extension Setting: A tutorial program provided for the product is used as an example. For the tutorial program, refer to section 6, Tutorial, in the SuperH™ Family E10A-USB Emulator User's Manual.

The conditions of Event Condition are set as follows:

1. Ch3

   Breaks address H'00001068 when the condition [Only program fetched address after] is satisfied.
2. Ch2

   Breaks address H'0000107a when the condition [Only program fetched address after] is satisfied.
3. Ch1

   Breaks address H'00001086 when the condition [Only program fetched address after] is satisfied.

   Note: Do not set other channels.
4. Sets the content of the [Ch1,2,3] list box to [Break: Ch 3-2-1] in the [Combination action (Sequential or PtoP)] dialog box.
5. Enables the condition of Event Condition 1 from the popup menu by clicking the right mouse button on the [Event Condition] sheet.

Then, set the program counter and stack pointer (PC = H'00000800, R15 = H'00010000) in the [Registers] window and click the [Go] button. If this does not execute normally, issue a reset and execute the above procedures.

The program is executed up to the condition of Ch1 and halted. Here, the condition is satisfied in the order of Ch3 -> 2 -> 1.

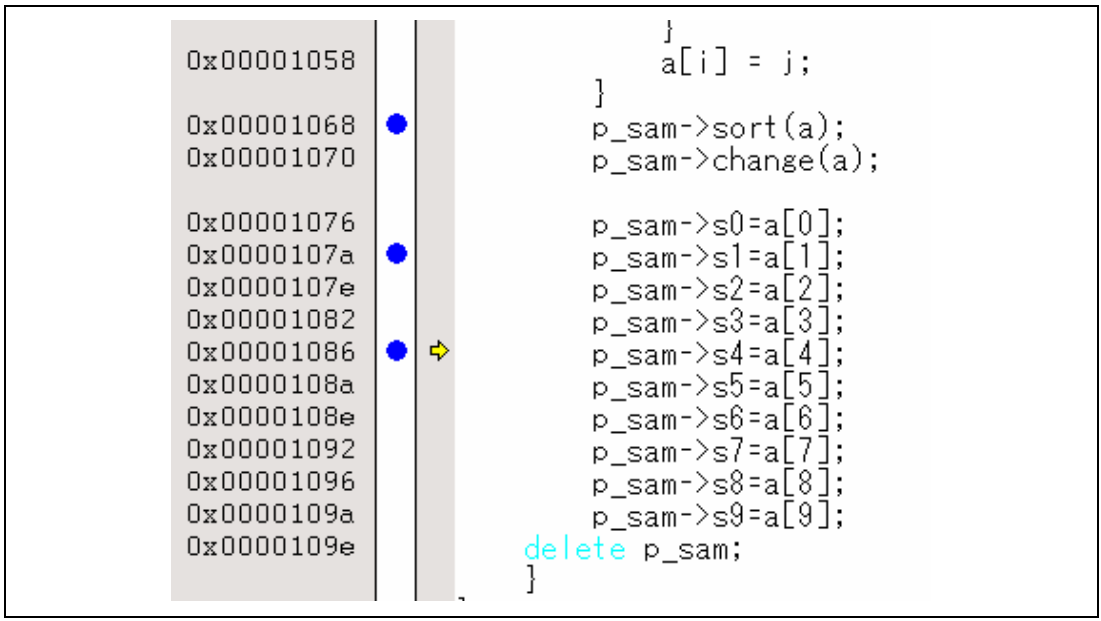


Figure 2.1 [Source] Window at Execution Halted (Sequential Break)

If the sequential condition, performance measurement start/end, or point-to-point for the internal trace is set, conditions of Event Condition to be used will be disabled. Such conditions must be enabled from the popup menu by clicking the right mouse button on the [Event Condition] sheet.

Notes: 1. If the Event condition is set for the slot in the delayed branch instruction by the program counter (after execution of the instruction), the condition is satisfied before executing the instruction in the branch destination (when a break has been set, it occurs before executing the instruction in the branch destination).

2. Do not set the Event condition for the SLEEP instruction by the program counter (after execution of the instruction).
   Do not set the data access condition before executing one or two instructions in the SLEEP instruction.

3. If the power-on reset and the Event condition are matched simultaneously, no condition will be satisfied.

4. If a condition of which intervals are satisfied closely is set, no sequential condition will be satisfied. Set the Event conditions sequentially, which are satisfied closely, by the program counter with intervals of two or more instructions.
   The CPU is structured as a pipeline; the order between the instruction fetch cycle and the memory cycle is determined by the pipeline. Accordingly, when the channel condition is matched in the order of bys cycle, the sequential condition is satisfied.

5. If the settings of the Event condition or the sequential conditions are changed during execution of the program, execution will be suspended. (The number of clocks to be suspended during execution of the program is a maximum of about 52 bus clocks (Bϕ). If the bus clock (Bϕ) is 10.0 MHz, the program will be suspended for 5.2 μs.)
6. If the settings of Event conditions or the sequential conditions are changed during execution of the program, the emulator temporarily disables all Event conditions to change the settings. During this period, no Event condition will be satisfied.
7. If the satisfaction is contended between the DTC transfer and conditions of Event Condition including the external bus access condition, the followings may be disabled: generation of a break after the satisfaction of conditions of Event Condition, halting and acquisition of the internal trace, and the start or end of performance measurement.
8. When the emulator is being connected, the user break controller (UBC) function is not available.

2.2.2 Trace Functions

The internal trace is available for acquiring information on up to four branch instructions (including both the branch source and destination addresses). The AUD trace is not available when the SH7136 or SH7137 is in use.

2.2.3 Notes on Using the JTAG (H-UDI) Clock (TCK)

1. Set the JTAG clock (TCK) frequency to 1/4 or lower than the frequency of the peripheral clock (Pϕ) and to 2 MHz or more.
2. The initial value of the JTAG clock (TCK) is 2.5 MHz.
3. A value to be set for the JTAG clock (TCK) is initialized after executing [Reset CPU] or [Reset Go]. Thus the TCK value will be 2.5 MHz.

2.2.4 Notes on Setting the [Breakpoint] Dialog Box

1. When an odd address is set, the next lowest even address is used.
2. A BREAKPOINT is accomplished by replacing instructions of the specified address. .
   It cannot be set to the following addresses:
   — An area other than CS, the internal RAM, and the internal flash memory
   — An instruction in which Break Condition 2 is satisfied
   — A slot instruction of a delayed branch instruction
3. During step operation, specifying BREAKPOINTs and Event Condition breaks are disabled.
4. When execution resumes from the address where a BREAKPOINT is specified and a break occurs before Event Condition execution, single-step operation is performed at the address before execution resumes. Therefore, realtime operation cannot be performed.
5. If an address of a BREAKPOINT cannot be correctly set in the ROM or external flash memory area, a mark ● will be displayed in the [BP] area of the address on the [Source] or [Disassembly] window by refreshing the [Memory] window, etc. after Go execution. However, no break will occur at this address. When the program halts with the event condition, the mark ● disappears.

2.2.5 Notes on Setting the [Event Condition] Dialog Box and the BREAKCONDITION_SET Command

1. When [Go to cursor], [Step In], [Step Over], or [Step Out] is selected, the settings of Event Condition 3 are disabled.
2. When an Event Condition is satisfied, emulation may stop after two or more instructions have been executed.

2.2.6 Performance Measurement Function

The emulator supports the performance measurement function.

1. Setting the performance measurement conditions

   To set the performance measurement conditions, use the [Performance Analysis] dialog box and the PERFORMANCE_SET command. When any line in the [Performance Analysis] window is clicked with the right mouse button, a popup menu is displayed and the [Performance Analysis] dialog box can be displayed by selecting [Setting].

Note: For the command line syntax, refer to the online help.

(a) Specifying the measurement start/end conditions

The measurement start/end conditions are specified by using Event Condition 1,2. The [Ch1,2,3] list box of the [Combination action (Sequential PtoP)] dialog box can be used.

Table 2.15 Measurement Period

Classification	Item	Description
Selection in the [Ch1, 2, 3] list box	Ch2 to Ch1 PA	The period from the satisfaction of the condition set in Event Condition 2 (start condition) to the satisfaction of the condition set in Event Condition 1 (end condition) is set as the performance measurement period.
	Ch1 to Ch2 PA	The period from the satisfaction of the condition set in Event Condition 1 (start condition) to the satisfaction of the condition set in Event Condition 2 (end condition) is set as the performance measurement period.
	Other than above	The period from the start of execution of the user program to the occurrence of a break is measured.

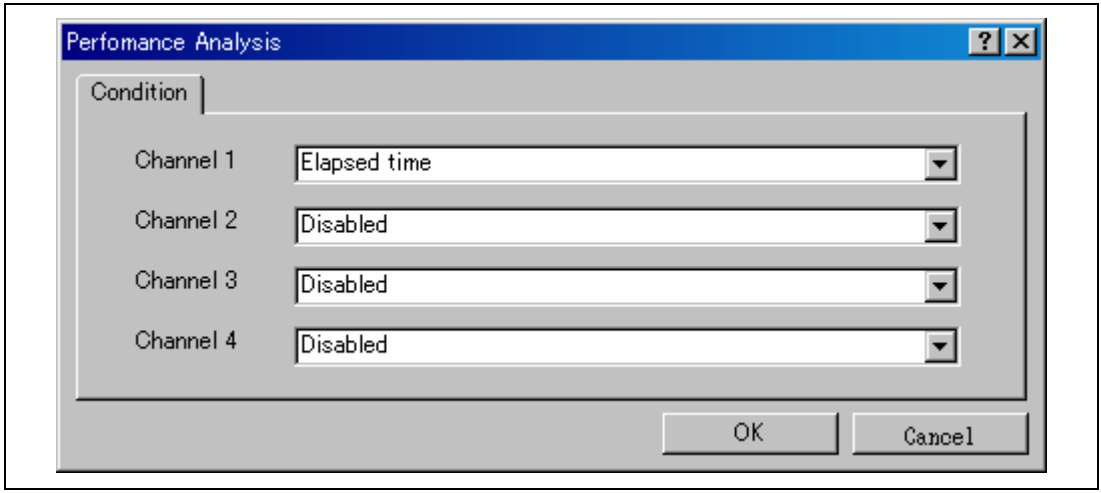


Figure 2.2 [Performance Analysis] Dialog Box

For measurement tolerance,

- The measured value includes tolerance.
- Tolerance will be generated before or after a break.

Note: When [Ch2 to Ch1 PA] or [Ch1 to Ch2 PA] is selected, to execute the user program, specify conditions set in Event Condition 2 and Event Condition 1 and one or more items for performance measurement.

(b) Measurement item

Items are measured with [Channel 1 to 4] in the [Performance Analysis] dialog box. Maximum four conditions can be specified at the same time. Table 2.16 shows the measurement items.

Table 2.16 Measurement Item

Selected Name	Option
Disabled	None
Elapsed time	AC (The number of execution cycles (Iϕ) is set as the measurement item.)
Number of execution states	VS
Branch instruction counts	BT
Number of execution instructions	I
Exception/interrupt counts	EA
Interrupt counts	INT
URAM area access counts	UN
URAM area instruction access counts	UIN
URAM area data access counts	UDN

Note: Selected names are displayed for CONDITION in the [Performance Analysis] window. Options are parameters for <mode> of the PERFORMANCE_SET command.

Each measurement condition is also counted when a condition in table 2.17 is generated.

Table 2.17 Performance Measurement Condition to be Counted

Measurement Condition	Notes
Branch count	The counter value is incremented by 2. This means that two cycles are valid for one branch.

Notes: 1. In the non-realtime trace mode of the AUD trace, normal counting cannot be performed because the generation state of the stall or the execution cycle is changed.
2. When the CPU clock is halted in the mode, such as sleep, counting is also halted.
3. When the measurement start or end condition is set, counting is halted if a power-on reset is input after and before the satisfaction of measurement start and end conditions.

2. Displaying the measured result

The measured result is displayed in the [Performance Analysis] window or the PERFORMANCE_ANALYSIS command with hexadecimal (32 bits).

Note: If a performance counter overflows as a result of measurement, "********" will be displayed.

3. Initializing the measured result

   To initialize the measured result, select [Initialize] from the popup menu in the [Performance Analysis] window or specify INIT with the PERFORMANCE_ANALYSIS command.

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Additional Document for User's Manual
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